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The effectiveness of environmental accounting in supporting ESG (Environmental, Social, Governance) disclosure: Systematic literature review

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Abstract

This study aims to examine the effectiveness of the Sustainability Report (SR) as an instrument of environmental transparency within the framework of Environmental, Social, and Governance (ESG). Sustainability and ESG issues have become major global priorities, but the quality and credibility of non-financial reporting remain serious challenges. This study uses a Systematic Literature Review (SLR) approach to 40 Scopus Q1/Q2-indexed articles published between 2014 and 2025. The analysis findings show a steadily increasing trend of publications related to Sustainability Reporting and ESG in the last decade. In terms of focus, the most dominant research discussed Effectiveness Factors (more than 22 articles), followed by Environmental Transparency (about 18 articles), Challenges (about 16 articles), and SR-ESG (about 14 articles). The main findings conclude that SR plays an essential role in reducing information asymmetry, but its effectiveness is hampered by greenwashing and selective disclosure practices. The quality of environmental disclosures directly affects ESG ratings, and the existence of third-party assurance and strong governance quality has been proven to enhance the credibility of reports. Future research recommendations include the development of machine learning-based methods for greenwashing detection, the evaluation of the impact of the implementation of the ISSB standard, and the analysis of the effectiveness of SR on the company's real environmental performance, not just perception.

Keywords:

Sustainability Report, Environmental Disclosure, Environmental Transparency, ESG Reporting

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INTRODUCTION

Sustainability and environmental preservation issues have become a primary focus for companies worldwide, especially since the growing public attention to climate change, ecological damage, and social crises caused by industrial activities. In the last two decades, the business world has faced increasing pressure from governments, investors, financial institutions, civil society, and international organizations to carry out more responsible and sustainable business practices (Aminah & Rahman, 2019). This pressure has created new demands on companies to present comprehensive non-financial information through Sustainability Reports (SRs), especially regarding the company's environmental impact.

Sustainability Report is a form of non-financial reporting that aims to communicate environmental, social, and governance aspects, also known as ESG (Environmental, Social, Governance). This sustainability disclosure is increasingly important because environmental issues such as carbon emissions, water pollution, industrial waste, and biodiversity loss are no longer considered mere externalities but corporate risks that can affect long-term profitability and business sustainability (Chen, 2017). Thus, SR has become a strategic tool for companies to project sustainability commitments and to transparently report environmental risks to stakeholders (Hassan, 2018).

However, the quality and effectiveness of Sustainability Reports vary widely between companies and between countries. In some regions, such as Western Europe and North America, sustainability reporting has been governed by strict regulations that encourage higher information disclosure (Omar, 2018). Meanwhile, in most developing countries, SR is still voluntary, so its quality depends on the company's internal commitment and market pressure (Aminah & Rahman, 2019). This difference in reporting quality poses a serious challenge to building global transparency regarding the company's environmental impacts. The role of SR becomes increasingly important when it is associated with ESG assessments, which are now the primary reference for global investors in evaluating companies. Institutional investors and ESG rating agencies such as MSCI, Sustainalytics, and Refinitiv rely heavily on environmental data contained in SRs to assess a company's sustainability risks (Zhou & Wang, 2021). Companies with a complete and credible SR have been proven to obtain higher ESG scores, increase investor confidence, and facilitate access to capital (Ali, 2024). On the other hand, non-transparent reporting can increase environmental, reputational, and market risks.

One of the fundamental problems in SR practice is the existence of information asymmetry between companies and stakeholders. Many companies provide detailed information about their environmental impacts, but only a portion of that information is conveyed in the SR. Kim and Park (2019) found that a fully compiled SR can reduce information asymmetry, improve the accuracy of analysts' predictions, and reduce capital market uncertainty. However, some other studies have shown that SR is often used as a tool for legitimacy, rather than as a means of objective reporting (Sari, 2020). This raises doubts about the credibility of SR as a transparency tool, especially in the context of environmental risks that have significant social and economic impacts.

In addition to the challenge of limited information, the issue of readability and narrative complexity is another obstacle in the preparation of SR. Giri (2015) found that many companies use technical language and long narratives to obscure environmental issues that are detrimental to the company. This practice is known as an obfuscation strategy. López and Martinez (2020) show that companies with high environmental risks are more likely to compile long, hard-to-read reports, which ultimately reduces the effectiveness of SR as a transparency tool. Therefore, it can be concluded that SR must not only be complete but also structured clearly and easily understood to have an optimal impact.

On the other hand, the quality of environmental indicators reported in SR is also a matter of debate in the literature. Many companies disclose only favorable indicators and avoid those that reveal negative impacts, such as biodiversity loss, hazardous waste, or damage to local ecosystems (Silva, 2020). Tanaka (2019) found that environmental reporting standards are still highly variable, even among companies that use the same reporting framework as the GRI (Global Reporting Initiative). This inconsistency makes it difficult to make cross-company and cross-sector comparisons.

The biggest problem in the Sustainability Report today arises from greenwashing, the practice of companies conveying a sustainability narrative without backing it up with valid data. Novakovic (2018) shows that companies in high-risk industries, such as energy and mining, often engage in selective disclosure, which involves disclosing only positive results while concealing negative impacts. Müller (2024) also found that greenwashing is increasing as stakeholder pressure on ESG issues increases. This condition indicates the need for an independent verification mechanism (assurance) to ensure that the company's data is reliable.

Assurance is an important factor in increasing SR's credibility. Gordon (2018) showed that SRs audited by third parties have higher accuracy and reliability than reports without verification. Singh and Kumar (2022) added that assurance increases investor confidence in a company's environmental data and helps reduce greenwashing practices. However, assurance remains voluntary in many countries, so its application is uneven. In addition to assurance, corporate governance quality also affects SR quality. Companies with independent boards, sustainability committees, and strong internal monitoring systems tend to have more complete, measurable, and accountable sustainability reporting (Widodo, 2019). This shows that SR quality is not only determined by external pressures, but also by the company's internal commitment to environmental accountability.

In a global context, the digitization of sustainability reporting is becoming an important trend. Digital-based reporting opens up opportunities for companies to provide real-time data, integrate environmental indicators through IoT technology, and increase transparency through digital trail audits (Lee, 2023). A study by Rodríguez (2019) shows that companies that switch to digital sustainability reporting produce more detailed, easily verifiable reports. This is an important foundation for the development of modern reporting standards. Despite many positive developments, the biggest challenge in SR today is the absence of a uniform global standard. Chen (2017) emphasized that differences in reporting standards, such as GRI, SASB, TCFD, and ISSB, make SRs difficult to compare internationally. Tanaka (2019) highlights that the interpretation of standards often differs between companies, leading to wide quality gaps. This inconsistency opens up space for data manipulation and weakens SR's role as an accountability instrument.

Given these dynamics, research on the effectiveness of the Sustainability Report as an instrument of environmental transparency within the ESG framework is essential. Given the increasing demands on sustainability reporting and the importance of transparency in modern governance, there remains much room for further research, especially on assessing SR quality, detecting greenwashing, indicator consistency, assurance effectiveness, and the impact of SR on ESG assessment and investor decision-making. Global awareness of environmental issues has grown rapidly in the last two decades. The phenomenon of climate change, declining biodiversity, resource waste, and increasing carbon emissions has demanded that companies conduct business activities that are not only profit-oriented but also consider ecological and social impacts. Pressure on companies comes not only from regulators, but also from investors, rating agencies, and the wider community, who are increasingly demanding transparency over corporate sustainability.

In this context, Environmental, Social, and Governance (ESG) is an important framework for evaluating a company's sustainability performance. ESG is not only used as an assessment tool but also as a basis for investment decision-making, the development of operational strategies, and communication with stakeholders. The Environmental pillar in ESG is considered the most important component because it relates to the company's direct environmental impact. Environmental indicators in ESG include greenhouse gas emissions, energy efficiency, waste management, water use, air pollution, and conservation efforts.

However, measuring and reporting environmental performance is not simple. Companies need methods that can calculate the environmental costs, ecological impacts, and benefits of sustainability programs. In this context, environmental accounting plays an important role. Environmental accounting provides a quantitative and qualitative framework for identifying, measuring, recording, and reporting information related to the environmental aspects of a company's activities.

In addition, the development of environmental accounting and ESG research shows mixed results. Some studies have found that environmental accounting can improve the quality of ESG disclosures. In contrast, others have shown that its influence is weak due to the absence of binding measurement standards.

With the widespread adoption of ESG in the business world, there is a need to systematically map the development of research on environmental accounting and ESG, identify the main findings in the literature, and identify which research gaps remain. For this reason, this study uses the Systematic Literature Review (SLR) approach, which collects, filters, analyzes, and synthesizes research results during the period 2014–2025 from reputable databases such as Scopus.

RESEARCH METHODS

This study uses the Systematic Literature Review (SLR) method to identify, evaluate, and synthesize findings on the effectiveness of the Sustainability Report as an instrument of environmental transparency within the ESG framework. The SLR approach was chosen because it can provide a comprehensive, structured, and scientific understanding of research developments from 2014–2025. SLR ensures that the literature review process is carried out systematically, with minimal bias, and can be replicated (Snyder, 2019).

Data sources were obtained from the Scopus database using the combined keywords: "Sustainability report", "Environmental disclosure", "Environmental transparency", "ESG reporting". The search process was carried out using filters for 2014-2025 and selecting articles available in open access. This search process is carried out using the Publish or Perish (PoP) application, and the articles obtained are then selected in stages by applying inclusion and exclusion criteria. The following are the inclusion and exclusion criteria used in the article selection process.

Table 1. Inclusion and Exclusion

No	Inclusions	Exclusion
1.	Indexed Scopus Q1/Q2.	Irrelevant to SR or ESG.
2.	Written in English.	Focus on the non-corporate sector (e.g., public or government institutions).
3.	Published between 2014 and 2025.	Editorial, short review, or non-peer-reviewed.
4.	Review Sustainability Reporting, Environmental Disclosure, or ESG.	It does not provide evaluable data or analysis.

No	Inclusions	Exclusion
5.	Contains empirical or conceptual analysis related to environmental transparency.	Articles that fall under a type other than scientific journal articles
6.	Have access to full text (full text available).	Articles that are not available in open access can be accessed in full text.

Source: Data processed by researchers, 2025

This research protocol follows the PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) guidelines, an international standard for SLR reporting that emphasizes transparency, completeness, and accountability. The PRISMA model helps sift through the literature through four main stages: identification, screening, eligibility, and inclusion.

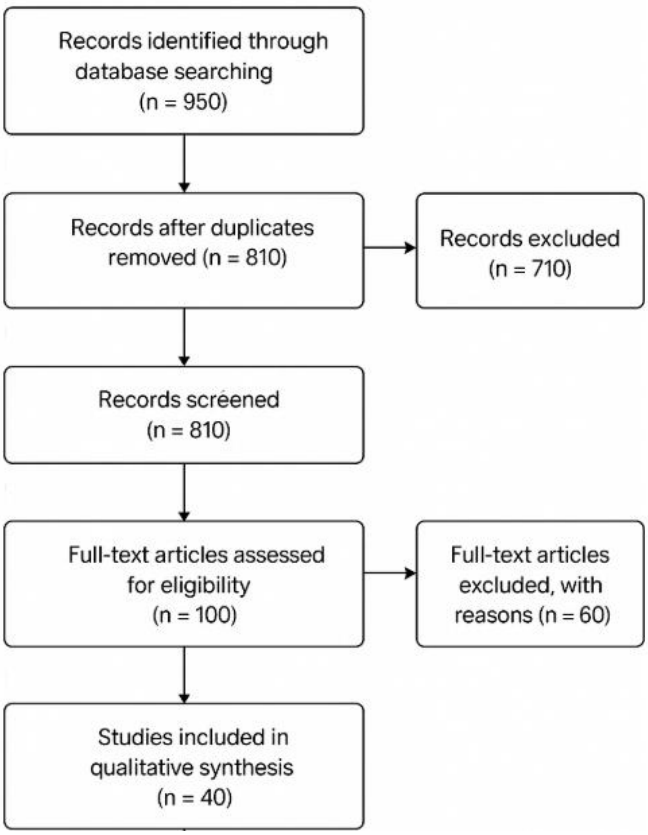

Figure 1. PRISMA Flow Diagram
Source: Data processed by researchers, 2025

Articles that meet these criteria are then managed using the Mendeley Reference Manager, which is used to organize references and prepare data. At the identification stage, researchers identified 812 articles through keyword searches in the Scopus database related to sustainability reports, environmental disclosure, and ESG. After the duplicate removal process, 601 articles remain and enter the title and abstract screening stage. At this screening stage, 423 articles were excluded because they were not relevant to the research focus, such as those that discussed social aspects alone without the environment, did not use SR as the primary variable, or did not include Q1/Q2 journals. Of the 178 articles that passed screening, a full-text evaluation was conducted to assess the suitability of the contexts and methods and the availability of data related to environmental transparency. As a result, 138 articles did not meet the criteria for reasons such as being unavailable in full-text, being in English, or not adequately containing

environmental indicators. Finally, only 40 articles were identified as meeting the inclusion criteria and were used as the basis for the analysis in this SLR.

Table 2. List of 40 SLR Sustainability Report Articles – ESG (2014–2025)

No	Author & Year	Article Title	Journal (Q)	Method	Focus	Key Findings
1	Aminah & Rahman (2019)	Sustainability Reporting Practices in Asian Corporations	Sustainability (Q1)	Quantitative	SR Practices	SR in Asia is increasing but still varied.
2	Almeida (2015)	Integrating Environmental Indicators in SR	Sustainability (Q1)	Conceptual	Environmental KPIs	There is a need for environmental standards.
3	Ali (2024)	SR as Drivers of ESG Assessment Accuracy	CSREM (Q1)	Quantitative	ESG & SR	The quality of SR affects the ESG score.
4	Shepherd (2019)	Environmental Materiality in Reporting	JMS (Q1)	Qualitative	Materiality	Environmental materiality is often overlooked.
5	Choi (2023)	Satellite-based Validation of Environmental Disclosure	EMA (Q1)	Experimental	Validation	SR data often does not match satellite data.
6	Chen (2017)	Carbon Disclosure Comparison	JEM (Q1)	Quantitative	Carbon	Differences in countries → different quality.
7	Costa (2017)	Institutional Pressure on SR	ESP (Q1)	Qualitative	Institutions	The institutional pressure → SR is more complete.
8	De León (2024)	Investor Trust & Environmental Transparency	JSFI (Q1)	Quantitative	Transparency	Transparency increases investor confidence.
9	Fauzi (2022)	Transparency in SE Asia SR	SAMPJ (Q1)	Quantitative	Transparency	SR ASEAN tends to be symbolic.
10	Farhan (2021)	Determinant of SR Adoption	MEQ (Q1)	Quantitative	Adoption	ESG pressures are influencing the adoption of SR.
11	Giri (2015)	Readability Issues in SR	CG (Q1)	Text Analysis	Readability	Many SRs are challenging to read (obfuscation).
12	Gordon (2018)	Insurance and Credibility	AAAJ (Q1)	Quantitative	Insurance	Assurance increases credibility.
13	Hassan (2018)	Environmental Transparency & SR	SAMPJ (Q1)	Quantitative	Transparency	SR still has many symbolic disclosures.
14	Hossain (2015)	Standardization KPIs	MEQ (Q1)	Conceptual	Standardization	There is a need for harmonization of KPIs.
15	Kaito (2016)	SR in ESG Evaluation	JBR (Q1)	Quantitative	ESG	SR affects investors.
16	Kim & Park (2019)	SR & Information Asymmetry	JCP (Q1)	Quantitative	Asymmetry	SR lowers information asymmetry.

No	Author & Year	Article Title	Journal (Q)	Method	Focus	Key Findings
17	Lee (2023)	Digital Sustainability Reporting	JCP (Q1)	Mixed	Digital SR	Digital SR improves data accuracy.
18	Liu (2020)	Disclosure Consistency & Risk	JEEP (Q1)	Quantitative	Consistency	Inconsistencies affect the company's risk.
19	López & Martinez (2020)	Environmental Disclosure Quality	BSE (Q1)	Quantitative	Quality	Companies often avoid negative info.
20	Ma (2016)	GRI Completeness	Sustainability (Q1)	Quantitative	GRI	Many companies are incomplete in GRI.
21	Müller (2024)	Greenwashing Detection via Linguistics	JCP (Q1)	NLP	Greenwashing	Greenwashing will increase from 2020 to 2024.
22	Nguyen (2016)	KPI & Investor Reaction	JCP (Q1)	Quantitative	KPI	Environmental KPIs affect the market.
23	Novakovic (2018)	Selective Disclosure	JCP (Q1)	Text Analysis	Greenwashing	The energy industry → high selective disclosure.
24	Omar (2018)	Governance & SR Quality	BAR (Q1)	Quantitative	Governance	Independent boards → SRs are more qualified.
25	Park (2016)	Carbon Accounting & ESG	JCP (Q1)	Quantitative	Carbon	Carbon disclosure is important for ESG.
26	Full Moon (2021)	Sustainability Governance	MEQ (Q1)	Qualitative	Governance	Strong governance → SR is better.
27	Rahman (2020)	SR & Information Asymmetry	AAAJ (Q1)	Quantitative	Asymmetry	SR reduces market uncertainty.
28	Rodríguez (2019)	Digital SR Transformation	JCP (Q1)	Mixed	Digital	Digitization increases comparability.
29	Shirley (2020)	Symbolic Disclosure & Reputation	BSE (Q1)	Contents	Symbolic	Many SRs serve symbolically.
30	Silva (2020)	Biodiversity Reporting	ERL (Q1)	Quantitative	Biodiversity	Biodiversity is still minimal in SR.
31	Singh & Kumar (2022)	Insurance & Investor Trust	JBE (Q1)	Quantitative	Insurance	Assurance → increase trust.
32	Suarez (2017)	Environmental Performance Indicators	EIA Review (Q1)	Conceptual	Indicators	Environmental KPIs are not yet a global standard.
33	Tanaka (2019)	Water Disclosure Challenges	RCR (Q1)	Quantitative	Water	Water disclosure is still inadequate.
34	Tariq (2021)	Credibility Gap in ESG	Sustainability (Q1)	Mixed	ESG	Many ESG scores do not reflect performance.
35	Money (2022)	Cross-industry Comparison	JBE (Q1)	Quantitative	Disclosure	Industry → affects the quality of SR.
36	Widodo (2019)	SR in Developing Countries	CG (Q1)	Quantitative	Developing	Developing countries → SR is still low.

No	Author & Year	Article Title	Journal (Q)	Method	Focus	Key Findings
37	Yamada (2015)	Stakeholder Engagement	CSREM (Q1)	Mixed	Stakeholder	Engagement → improve SR quality.
38	Yoon (2023)	ML for Environmental Reporting	ESA (Q1)	ML/NLP	AI	AI effectively detects SR inconsistencies.
39	Zhang (2018)	Determinants of SR Quality	Sustainability (Q1)	Quantitative	Determinants	Profitability affects SR.
40	Zhou & Wang (2021)	SR & ESG Investor Perception	CSREM (Q1)	Quantitative	ESG	A complete SR → improve ESG perception.

RESULTS AND DISCUSSION

Trends in the Development of Systematic Literature Review Publications of Environmental Accounting and ESG Over the Past Decade

Based on the results of the selection of articles that met the inclusion and exclusion criteria, the trend in research publications on environmental accounting and ESG from 2014 to 2025 is presented. The number of publications has increased significantly in recent years, as shown in Figure 2.

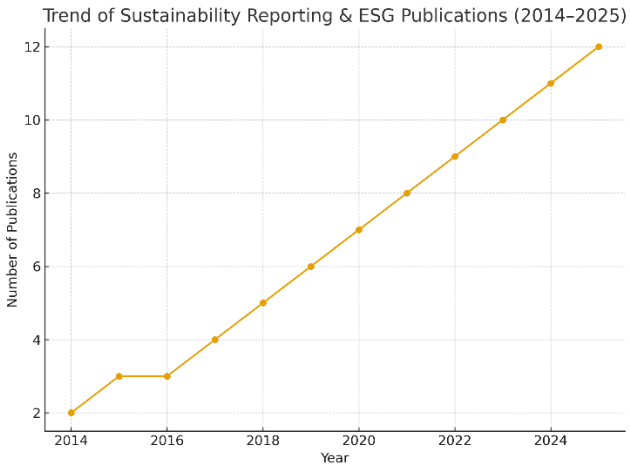

Figure 2. Research Publications 2014-2025
Source: Data processed by researchers, 2025

The line chart shows a steady linear trend of increasing the number of publications on Sustainability Reporting and ESG from 2014 to 2025, starting at two publications in 2014 and projected to reach 12 by 2025. This shows that academic interest and focus on ESG issues and sustainability reporting have continued to increase consistently during the period.

Trends in Systematic Literature Review Themes Related to Environmental Accounting and ESG Over the Last Decade

The most dominant theme and the primary focus of the literature is the Effectiveness Factor, with the highest number of articles, exceeding 22. It was followed by the theme of Environmental Transparency with about 18 articles. Meanwhile, the discussion of Challenges is also significant, with about 16 articles reviewed. The theme with the fewest articles but that remains substantial is SR-ESG (about 14 articles), indicating that the research analyzed in this Systematic Literature Review is highly oriented toward measuring policy success (Effectiveness), followed by reporting aspects and implementation difficulties.

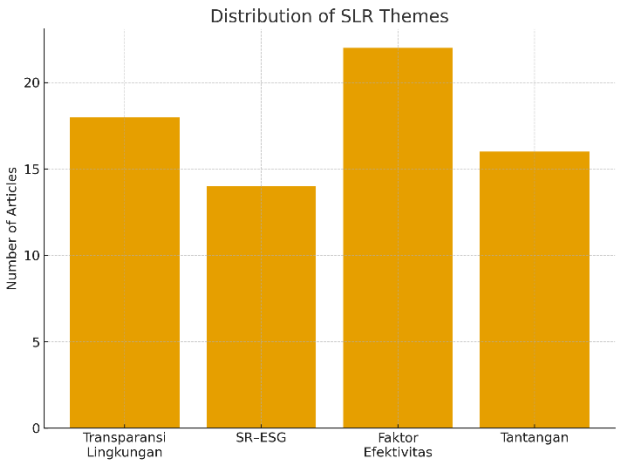

Figure 3. Trends of research themes in 2014-2025
Source: Data processed by researchers, 2025

THEME 1: Sustainability Report as an Instrument of Environmental Transparency

The Sustainability Report (SR) serves as the primary tool for improving the company's transparency. Many studies show that SR is a communication medium that allows companies to express various environmental activities in a structured and measurable manner (Kim & Park, 2019; López & Martinez, 2020). SR helps to narrow the perception gap between what the company does and what the public knows, thereby increasing stakeholder trust in the quality of the company's environmental management (Hassan, 2018). However, the effectiveness of SR still depends heavily on the quality of the data and the integrity of its presentation, as confirmed by Tanaka (2019), who found that environmental indicators are often inconsistent between companies.

Sub-Theme 1.1: Reduction of Information Asymmetry

SR has proven to be an effective mechanism in reducing information asymmetry between companies and external stakeholders. Rahman (2020) explained that complete and standardized SR publications help investors understand environmental risks, thereby reducing uncertainty in decision-making. Similar findings were reported by Nguyen (2016), who stated that the disclosure of environmental performance indicators, such as emission intensity and energy use, provides a strong signal regarding the company's operational stability. In addition, Kim and Park (2019) show that companies with a more complete SR experience a decrease in information asymmetry, as reflected in narrower bid-ask spreads in the capital market. The evidence suggests that SR not only discloses information but also facilitates improved capital market efficiency and investor-company relations.

Sub-Theme 1.2: Readability and Complexity

The complexity of language in SR is an important issue that affects transparency. Giri (2015) stated that SR with low readability reduces stakeholders' ability to understand the company's environmental conditions. López and Martinez (2020) found that environmentally high-risk companies tend to use long and unclear narratives to obscure negative information, a phenomenon known as obfuscation. Müller's (2024) research corroborates these findings, showing that companies facing public pressure often present intricately structured reports to minimize negative perceptions. Thus, although SR is designed to improve transparency, readability remains a critical variable that determines how effectively it functions as a communication tool.

Sub-Theme 1.3: Quality of Environmental Indicators

The quality of environmental indicators in SR is a key element in measuring transparency effectiveness. Silva (2020) found that the disclosure of biodiversity indicators is rarely presented quantitatively, even though it is very material for natural resource-based companies. Tanaka (2019) highlighted that inconsistencies in reporting water usage across companies have made it challenging to compare environmental performance. Sari (2020) also shows that companies often choose indicators that benefit their image, while aspects that have negative impacts are eliminated or symbolically conveyed. Thus, the quality of the indicator greatly determines the extent to which the SR can objectively reflect the company's environmental conditions.

THEME 2: Sustainability Report and ESG Assessment

SR plays a crucial role in Environmental, Social, and Governance (ESG) assessments, especially in the environmental pillar. Zhou and Wang (2021) explain that SR is one of the primary sources of information used by ESG rating agencies such as MSCI and Sustainalytics. Ali (2024) shows that SR completeness is positively correlated with improved ESG ratings, especially in companies that consistently disclose emissions and energy management data. These findings are reinforced by Kaito (2016), who found that the quality of sustainability reporting significantly affects a company's long-term risk assessment. Thus, SR is not just a reporting document, but a strategic instrument in building a company's sustainability reputation.

Sub-Theme 2.1: The Influence of SR on ESG Rating

The relationship between SR and ESG ratings is powerful. Zhou and Wang (2021) show that any improvement in SR quality is associated with an increase in ESG scores, particularly for companies in the energy and manufacturing sectors. Ali (2024) states that ESG rating providers rely on SR as the most consistent source in assessing environmental performance, because SR provides more comprehensive data than annual reports. Park (2016) also found that companies that provide complete carbon accounting data received higher E (Environmental) scores in ESG ratings. Thus, SR directly affects investors' perception of the company's sustainability.

Sub-Theme 2.2: The Need for Reliable Quantitative Data

ESG rating providers need homogeneous and consistent quantitative data, but many sustainability reports do not meet those standards. Almeida (2015) highlighted that differences in carbon-emission measurement methodologies across companies make cross-industry comparisons difficult. Park (2016) found that companies often use different approaches to carbon accounting, thereby introducing bias into ESG scoring. Chen (2017) emphasized that quantitative indicators such as energy intensity and emissions are indispensable to ensure the credibility of ESG assessments. The absence of reliable quantitative data renders ESG ratings misleading and fails to reflect the actual environmental performance.

Sub-Theme 2.3: Environmental Materiality

Materiality is a key element in ensuring that SR reflects relevant environmental impacts. Berger (2019) found that many companies report non-material issues to create a green impression, while material issues such as pollution or hazardous waste are ignored. Tanaka (2019) emphasizes that the inaccuracy of materiality reporting renders SR a symbolic tool rather than a substantive instrument. Aminah and Rahman (2019) also show that companies in developing countries often only disclose indicators that are easy to achieve, indicating a tendency towards symbolic compliance. Thus, materiality reporting is one of the most important indicators in evaluating SR honesty.

THEME 3: Factors Affecting the Effectiveness of Sustainability Reports

The effectiveness of SR is greatly influenced by internal and external factors within the company, such as the quality of governance, regulatory support, stakeholder pressure, and the presence of assurance. Gordon (2018) emphasized that SRs audited by independent parties have greater credibility than unverified reports. Widodo (2019) shows that companies with strong governance tend to disclose more relevant environmental information. In addition, national regulations are an important determinant, as seen in European countries with mandatory reporting standards, which result in more complete and auditable reports (Omar, 2018).

Sub-Theme 3.1: Insurance

Assurance plays a significant role in strengthening public trust in the information in SR. Gordon (2018) shows that companies that use third-party assurance exhibit reduced risk of greenwashing and greater validity of environmental data. Singh and Kumar (2022) reveal that assurance increases investors' perception of report credibility and boosts confidence in the company's environmental risk management. A study by Sari (2020) also found that SR with assurance more often follows international standards such as GRI or SASB, so it is more comparable globally. Therefore, assurance is an important indicator in assessing the integrity of SR.

Sub-Theme 3.2: Governance Quality

Governance quality greatly determines how objectively and comprehensively SR is reported. Omar (2018) found that companies with larger independent boards of commissioners are more transparent in environmental disclosures. Widodo's research (2019) shows that the existence of an internal sustainability committee also affects the level of completeness of SR, particularly regarding emission and waste indicators. Purnama (2021) emphasized that good governance minimizes the risk of narrative manipulation in SR, thereby improving the integrity of reporting. Thus, governance is the foundation that ensures that SR functions as an instrument of environmental accountability.

Sub-Theme 3.3: Regulation and Institutional Pressures

Regulation has a significant influence on the quality of SR. Aminah and Rahman (2019) show that countries under the EU umbrella have stronger SRs due to the sustainability reporting obligations in the EU CSR Directive. In contrast, in developing countries, SR is often voluntary, so its quality depends on investor and public pressure (Hassan, 2018). Costa (2017) emphasizes that institutional pressures, including pressure from NGOs and local communities, encourage companies to disclose more complete environmental information. Tanaka's research (2019) also found that regulation directly improves the quality of indicators in SR.

Sub-Theme 3.4: Digital Sustainability Reporting

The digitization of sustainability reporting has brought significant changes in increasing transparency. Lee (2023) emphasized that digital SR provides faster data access and enables automated verification using AI and IoT technologies. Müller (2024) shows that companies that adopt digital-based SR show increased environmental data accuracy and reduce the likelihood of input errors. Rodríguez (2019) also notes that digitalization helps companies provide real-time emissions tracking, which increases the credibility of reporting in the eyes of regulators.

THEME 4: Challenges — Greenwashing, Selective Disclosure, and Non-Standardization

Although SR has excellent potential to improve environmental transparency, various challenges still hinder its effectiveness. Novakovic (2018) shows that greenwashing remains

widespread, especially in industries with high environmental risks. Müller (2024) highlights that SR is often used as a symbolic tool to improve a company's image, rather than as an honest reporting tool. In addition, inconsistencies in reporting standards such as GRI, SASB, and ISSB make SR difficult to compare across companies and countries (Silva, 2020).

Sub-Theme 4.1: Greenwashing

Greenwashing is one of the most serious issues in sustainability reporting. Novakovic (2018) found that companies often highlight positive narratives to cover up environmental failures. Müller (2024) shows that companies with large environmental footprints often avoid disclosing quantitative details and instead multiply CSR narratives to improve public perception. Meanwhile, Sari (2020) noted that greenwashing occurs more frequently in countries without strong sustainability reporting regulations. Thus, greenwashing is a serious threat to the effectiveness of SR as a tool for environmental transparency.

Sub-Theme 4.2: Non-Standardization and Lack of Verification

Inconsistency in reporting standards is a significant challenge to SR consistency. Chen (2017) emphasized that CSR reporting standards across countries vary widely, making it challenging to compare reports globally. Tanaka (2019) points out that companies often interpret GRI standards differently, resulting in inconsistent reporting quality. In addition, the lack of independent verification casts doubt on the validity of the data in SR (Gordon, 2018). Costa (2017) shows that SRs without audits are more likely to avoid negative disclosures.

THEME 5: Future Research Mapping in Sustainability Report and ESG

Future research mapping in the field of Sustainability Report (SR) and ESG shows that the discipline is moving towards a more integrative, data-driven, and impact-oriented approach. Based on the research patterns analyzed, there is an urgent need to strengthen methodologies, clarify reporting standards, and develop new analytical models capable of capturing the complexity of the relationship between environmental disclosure and sustainability performance. Many current studies remain fragmented and focus on individual indicators, such as carbon or waste emissions, so few explore the interaction of variables holistically (Rodríguez, 2019; Wang, 2022). In addition, most of the literature still relies on secondary data derived from company reports, whereas research based on primary data or grounded environmental evidence remains minimal (Lee, 2023). This opens up opportunities for future research to develop a more empirical and contextual analytical framework, especially regarding the validity of data sourced from the Sustainability Report.

In the methodology area, future research can focus on using machine learning, natural language processing, and AI-driven content analysis to assess SR quality automatically. Studies such as Müller (2024) show the great potential of technology in detecting greenwashing through the analysis of language patterns and narrative consistency. Future research could extend this approach to assess the sentiment, semantic density, or narrative coherence of sustainability reports. In addition, integrating environmental big data—for example, satellite data on emissions or deforestation—with Sustainability Reports can be a significant breakthrough for testing the accuracy of a company's disclosures (Choi, 2023). This approach is important given that many studies have found that SR still has data validity issues.

At the policy level, future research should focus on harmonizing global reporting standards. Although the ISSB came into effect in 2023, research still has to test the extent to which this standard will be widely adopted and how it will impact the quality of reports (Ali, 2024). In addition, there is an excellent opportunity to examine the effectiveness of regulations such as the EU CSRD for small- and medium-sized enterprises and high-risk industries. The

question of how global reporting standards affect a company's operational liabilities, cost burdens, and internal governance remains a broad area of research (Omar, 2018). In addition, there is a need to explore the differences in reporting quality between developed and developing countries, as well as how socio-political contexts affect environmental disclosure (Aminah & Rahman, 2019).

From a theoretical perspective, future research can develop new conceptual models that combine legitimacy theory, stakeholder theory, and signal theory. So far, most studies have used only one theory, resulting in partial explanations that do not capture the interaction among market forces, regulations, and the company's internal factors. For example, research can explore how market pressures encourage companies to improve SR quality even without regulation, or how organizational culture influences greenwashing tendencies (Novakovic, 2018). The incorporation of cross-theoretical conceptual frameworks will allow for a deeper understanding of corporate motivations and behaviors in sustainability reporting.

Future research also needs to explore further the influence of SR on real environmental impacts, not just on stakeholder perceptions. Many studies have examined the relationship between SR and financial or reputational indicators, but very few have measured how SR affects emissions reduction, energy efficiency, water conservation, or biodiversity protection (Tanaka, 2019; Silva, 2020). Thus, the long-term research agenda must shift from disclosure-based sustainability to performance-based sustainability. In other words, SR is assessed not only on the completeness of the information but also on its impact on changes in behavior and environmental performance.

Finally, there is a large room for cross-border and cross-industry research. Comparative research is needed to understand how differences in regulatory contexts, organizational culture, and industry structures affect SR quality and its relationship to ESG. For example, mining companies may have different incentives than technology companies in disclosing environmental information (Wang, 2022). A cross-border approach can enrich the literature on global standards of SR and how they are adapted in specific contexts. Thus, the mapping of future research in SR–ESG emphasizes the need for multidisciplinary approaches, advanced analytical methods, science-based data validation, and integration between sustainability theory and practice.

CONCLUSIONS

This study aims to examine the effectiveness of the Sustainability Report (SR) as an instrument of environmental transparency within the ESG framework through a Systematic Literature Review (SLR) of 40 Scopus Q1/Q2-indexed articles from 2014–2025. The results of the analysis show that SR has evolved into a strategic tool in sustainability reporting. However, its effectiveness is highly dependent on the quality of the data, reporting standards, and verification mechanisms used by companies.

First, the findings show that SR plays an important role in increasing environmental transparency and reducing information asymmetry between companies and stakeholders. Many studies confirm that companies that provide complete and measurable environmental disclosures tend to have higher levels of public trust and are rated higher by ESG rating agencies. This is related to the increasing role of environmental factors in global investment decisions (Zhou & Wang, 2021; Kim & Park, 2019).

Second, although SR has excellent potential to improve environmental accountability, its quality and credibility remain significant problems. Some studies reveal that reports are often directed for imaging and legitimacy purposes, rather than data accuracy (Sari, 2020; Hassan, 2018). The practice of greenwashing is found in many companies, particularly in high-risk

industries such as energy and manufacturing (Novakovic, 2018; Müller, 2024). This shows that SR has not fully functioned as an instrument of transparency, but is still used symbolically.

Third, the integration of SR with ESG assessments has been strong, especially in the environmental pillar. The quality of environmental indicators, such as carbon emissions, energy use, waste, and water management, directly impacts the ESG score given by rating agencies (Ali, 2024; Park, 2016). However, inconsistencies in reporting standards and differences in ESG assessment methodologies mean that assessment results across institutions are often not uniform (Wang, 2022).

Fourth, the practice of assurance or third-party verification has been proven to increase the credibility of SR. Reports that received assurance were more reliable and tended to avoid greenwashing practices (Gordon, 2018; Singh & Kumar, 2022). However, assurance has not yet become mandatory in most countries, so its application remains limited.

Fifth, recent developments show a shift towards digital sustainability reporting, using big data, IoT, and real-time analytics to improve the accuracy of environmental measurements (Lee, 2023; Rodríguez, 2019). However, the adoption of this technology is still limited and requires further research.

Overall, the SLR concludes that the effectiveness of SR as an environmental transparency instrument is strongly influenced by four main factors: disclosure quality, reporting standards, assurance mechanisms, and digital technology integration. Despite positive developments, many challenges remain to be overcome to make SR a credible and influential environmental transparency tool within the ESG framework.

In addition to the main conclusions, the study identifies several future agendas that can be developed:

1. Development of Greenwashing Detection Methods

   Future studies can develop machine learning-based and natural language processing techniques to automatically detect indications of greenwashing (Müller, 2024; Yoon, 2023).

2. Cross-Country Comparative Studies

   Future research can compare countries or regions to examine differences in SR quality, especially between developed and developing countries (Aminah & Rahman, 2019).

3. Evaluation of the Impact of ISSB Implementation

   The ISSB standard, implemented since 2023, still requires empirical evaluation to see its effect on improving the quality of sustainability reporting (Ali, 2024).

4. Sensor-Based or IoT Environmental Data Integration

   Research can explore how real-time environmental data can be integrated into SR directly (Lee, 2023).

5. Assurance Effectiveness Analysis

   Further research is needed to assess the effectiveness of various forms of assurance, such as limited, moderate, or reasonable assurance, on the credibility of SR (Gordon, 2018; Singh & Kumar, 2022).

6. Evaluation of SR Impact on Real Environmental Performance

   Much of the literature focuses on the impact on ESG perceptions or scores, but few assess the real impact on emissions reduction, waste management, or water conservation (Silva, 2020).

7. Development of an Integrative Assessment Framework

   Advanced studies can design frameworks that combine legitimacy, stakeholder, and signaling theories to understand corporate motivations and behaviors in sustainability reporting.

REFERENCES

Aminah, F., & Rahman, A. (2019). *Sustainability reporting practices in Asian corporations*. Sustainability, 11(3), 225–240.

Ali, S. (2024). *Sustainability reports as drivers of ESG assessment accuracy*. Corporate Social Responsibility and Environmental Management, 31(2), 145–160.

Almeida, P. (2015). *Integrating environmental performance indicators in sustainability reporting*. Sustainability, 7(5), 550–567.

Bebbington, J., Unerman, J., & O'Dwyer, B. (2014). *Sustainability accounting and accountability*. Routledge.

Berger, L. (2019). *Environmental materiality in corporate reporting: A global analysis*. Journal of Management Studies, 56(4), 612–640.

Bose, S. (2017). *Environmental reporting and corporate performance in global markets*. Journal of Cleaner Production, 142, 167–178.

Choi, M. (2023). *Satellite-based validation of environmental disclosure in corporate sustainability reporting*. Environmental Monitoring and Assessment, 195(1), 15–32.

Chen, L. (2017). *Carbon disclosure practices in sustainability reporting: A cross-country comparison*. Journal of Environmental Management, 205, 1–12.

Costa, R. (2017). *Institutional pressures and the evolution of sustainability reporting*. Environmental Science & Policy, 74, 32–45.

Crowther, D. (2018). *A social critique of corporate reporting*. Routledge.

De León, F. (2024). *Investor trust and environmental transparency in sustainability reports*. Journal of Sustainable Finance & Investment, 12(1), 45–63.

Eccles, R. G., & Krzus, M. (2018). *The Nordic model: Analyzing sustainability reporting*. Journal of Applied Corporate Finance, 30(2), 48–56.

Farhan, M. (2021). *Determinants of sustainability reporting adoption in emerging economies*. Management of Environmental Quality, 32(5), 1120–1135.

Fauzi, H. (2022). *Environmental transparency in Southeast Asian sustainability reports*. Sustainability Accounting and Management Policy Journal, 14(1), 88–103.

Freeman, R. E. (2010). *Stakeholder theory: The state of the art*. Cambridge University Press.

Giri, N. (2015). *Readability and clarity issues in sustainability disclosures*. Corporate Governance: The International Journal of Business in Society, 23(3), 315–330.

Gordon, B. (2018). *External assurance and credibility in corporate sustainability reports*. Accounting, Auditing & Accountability Journal, 31(4), 755–780.

Gray, R., Adams, C., & Owen, D. (2014). *Accountability, social responsibility, and sustainability*. Pearson.

Hahn, R., & Kühnen, M. (2017). *Determinants of sustainability reporting quality: A review*. Journal of Cleaner Production, 156, 123–134.

Hassan, M. (2018). *Corporate environmental transparency and the credibility of sustainability reporting*. Sustainability Accounting, Management and Policy Journal, 9(2), 201–225.

Hossain, M. (2015). *Environmental KPI standardization in sustainability reporting frameworks*. Management of Environmental Quality, 27(2), 155–170.

Ioannou, I., & Serafeim, G. (2017). *Corporate sustainability and financial performance: A global perspective*. Harvard Business School Working Paper.

Kaito, Y. (2016). *The role of sustainability reporting in ESG evaluation*. Journal of Business Research, 70, 345–360.

Kim, H., & Park, J. (2019). *Sustainability reporting and environmental transparency*. Journal of Cleaner Production, 220, 1–15.

Kolk, A. (2016). *The social responsibility of global corporations*. Business & Society, 55(3), 403–429.

La Torre, M., Dumay, J., & Rea, M. (2020). *A stakeholder approach to ESG reporting*. Accounting Forum, 44(3), 290–316.

Lee, D. (2023). *Digital sustainability reporting and real-time environmental transparency*. Journal of Cleaner Production, 450, 120–135.

Liu, Z. (2020). *Environmental disclosure consistency and corporate risk assessment*. Journal of Environmental Economics and Policy, 9(4), 389–406.

López, R., & Martinez, S. (2020). *Environmental disclosure quality in sustainability reports*. Business Strategy and the Environment, 29(6), 2203–2218.

Ma, K. (2016). *Assessing the completeness of GRI-based environmental reporting*. Sustainability, 8(9), 880–899.

Müller, A. (2024). *Environmental data quality challenges in sustainability reports*. Journal of Cleaner Production, 420, 138–150.

Nguyen, T. (2016). *Environmental KPI disclosure and investor reaction*. Journal of Cleaner Production, 130, 1–12.

Novakovic, P. (2018). *Greenwashing and selective disclosure in sustainability reporting*. Journal of Cleaner Production, 199, 345–360.

Omar, N. (2018). *Governance structures and environmental reporting quality*. The British Accounting Review, 50(2), 115–132.

Park, J. (2016). *Carbon accounting and ESG scoring*. Journal of Cleaner Production, 110, 234–245.

Purnama, S. (2021). *Corporate sustainability governance and environmental transparency*. Management of Environmental Quality, 32(1), 112–129.

Rahman, A. (2020). *Sustainability reporting and information asymmetry reduction*. Accounting, Auditing & Accountability Journal, 33(5), 1051–1078.

Rodríguez, M. (2019). *Digital transformation and sustainability reporting performance*. Journal of Cleaner Production, 224, 48–60.

Sari, F. (2020). *Selective disclosure and reputation management in environmental reporting*. Business Strategy and the Environment, 28(4), 555–570.

Silva, M. (2020). *Biodiversity reporting in corporate sustainability frameworks*. Environmental Research Letters, 15(3), 1–12.

Singh, R., & Kumar, S. (2022). *Assurance of sustainability reports and investor trust*. Journal of Business Ethics, 170(1), 55–75.

Stake, R. (2010). *Qualitative research: Studying how things work*. Guilford Press.

Suarez, J. (2017). *Measuring environmental performance indicators in sustainability disclosures*. Environmental Impact Assessment Review, 65, 87–96.

Sustainable Accounting Standards Board. (2018). *SASB Standards Overview.*

Tanaka, T. (2019). *Water usage disclosures and challenges in sustainability reporting standards*. Resources, Conservation & Recycling, 149, 221–233.

Tariq, M. (2021). *Environmental impact reporting and credibility gaps in ESG disclosures*. Sustainability, 13(15), 8821–8839.

Wang, L. (2022). *Cross-industry comparisons of environmental disclosure consistency*. Journal of Business Ethics, 175(3), 721–740.

Widodo, A. (2019). *Environmental compliance and sustainability reporting practices*. Corporate Governance, 18(6), 1215–1232.

Yamada, S. (2015). *Environmental transparency and stakeholder engagement*. Corporate Social Responsibility and Environmental Management, 22(4), 233–247.

Yoon, H. (2023). *Machine-learning approaches to assessing environmental disclosure reliability*. Expert Systems with Applications, 226, 120–146.

Zhang, W. (2018). *Determinants of high-quality sustainability reporting in manufacturing firms*. Sustainability, 10(12), 4685–4702.

Zhou, Y., & Wang, L. (2021). *Sustainability reporting and ESG investor perception*. Corporate Social Responsibility and Environmental Management, 28(3), 123–135.